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Lessons From Lebanon: Rubble Removal and Explosive Ordnance Disposal

Erik Lauritzen
Lauritzen Advising

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The insight and knowledge gained from rubble removal and explosive ordnance disposal in the Nahr el-Bared Camp, which was destroyed during heavy fighting in Lebanon in 2007, could greatly benefit future reconstruction efforts in war-damaged urban areas.

by Erik K. Lauritzen [Lauritzen Advising]

Part of the war-damaged Nahr el-Bared Camp in northern Lebanon, prior to the start of the rubble-removal project (August 2008).
All photos courtesy of the author.

Clearing damaged buildings in densely populated urban areas is a high-priority in the reconstruction of war-torn countries. After long periods of intense fighting, the need for unexploded ordnance (UXO) disposal, combined with rubble removal, increases the challenge of rebuilding.

Clearance of war-damaged buildings, recycling of building materials and explosive ordnance disposal (EOD) were essential phases of past urban reconstruction projects. Prominent examples included Beirut after the 15-year civil war (1975–1990), Sarajevo and Mostar, Bosnia-Herzegovina after the Bosnian War (1992–1995), and Kosovo after NATO intervention in 1999. In these locations, EOD units, specialized private groups or nongovernmental organizations (NGO) responded when rubble-removal contractors found UXO. Rubble removal ceased during the EOD projects but proceeded following EOD completion.

EOD organizations and rubble removal contractors cooperate through two different frameworks, depending on the level of contamination in an area. When the amount of UXO

found in the rubble is small or relatively low risk, on-call EOD support from teams or experts is the most efficient tactic. However, sometimes locations have high concentrations of bombs, mines, UXO or other sensitive explosive items. In this case EOD requires close support of experts or teams permanently on site. The reconstruction project in Nahr el-Bared Camp (NBC) was an example of this type of cooperation.

The NBC demonstrated how clearance can benefit from integrated rubble removal and EOD management in a post-conflict urban area. This camp offers insight for other post-conflict urban settings, including Syrian towns and cities currently experiencing heavy fighting near the Lebanese border such as Homs, An Nabk, Deir Attiyeh and Al-Qusayr.[1,2]

Nahr el-Bared Clearance

In 2007, NBC was the center of severe fighting between the Lebanese Armed Forces (LAF) and the militant Islamist group Fatah al-Islam. The destruction of a densely populated area of roughly 200,000 sq m (50 ac) displaced approximately 30,000 people.[3]

The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) commenced a major reconstruction project in September 2008. UNRWA and the United Nations Development Programme (UNDP) entered into an agreement on the management of NBC's rubble-removal and EOD projects. Following this agreement, UNDP signed a fixed-price, time-constrained (with penalties for missing deadlines) contract with the construction and demolition company Al-Jihad for Commerce and Contracting S.A.L. for the safe removal and treatment of approximately 500,000 cubic m (6,539,800 cubic yd) of rubble and waste material in an environmentally sound manner during an 18-month period. For EOD, UNRWA and Handicap International (HI) entered into a contract, which provisioned four EOD teams to search and clear all explosive items on-site in the above-ground rubble. HI performed the EOD operation according to the International Mine Action Standards (IMAS); HI's methods and procedures were approved by the Lebanese Mine Action Centre (LMAC).

The EOD contract was based on an assessment made by MAG (Mines Advisory Group), which revealed heavy UXO contamination in the northern area (red portion of Figure 1). Furthermore, LAF stated that during the fighting in 2007 four or five air bombs were dropped and not detonated in the NBC red zone.

Figure 1. Outline of the planned reconstruction of 20 ha (50 ac) divided into eight packages, starting with the reconstruction of package one, progressing in numerical order and ending with the completion of package eight.
Figure courtesy of UNDP and UNRWA.

The rubble-removal project aimed to integrate and optimize the work processes of the two contractors as quickly as possible. Success was determined as safe rubble removal and UXO clearance according to UNRWA's time schedule and the NBC reconstruction project. Contractually, NBC's reconstruction project was independent of the rubble-removal and EOD projects. However, reconstruction was contingent upon the time frame of the other projects and could not commence until completion of EOD and rubble removal.

The rubble removal and UXO-clearance project started in September 2008. The two tasks were done simultaneously and the project was completed on schedule in October 2009. The monitoring took place from the start of the project to September 2009, approximately one month before the end of the project.

Integrated Rubble Removal and EOD Process

The integrated rubble removal and EOD work involved

- Demolishing structures on and removing rubble from work sites
- Loading rubble onto trucks and transporting it from the work site to the laydown area for final inspection and additional UXO survey[4]
- Transporting rubble declared free of explosives by HI to the final disposal area

Each of HI's four EOD teams included a team leader and four UXO operators. The EOD and rubble-removal teams worked together to remove all rubble layer by layer and clear UXO until the terrain's surface was reached and cleared. The following procedures were used:

- EOD teams visually surveyed the work area before entering.
- UXO was removed and/or marked for destruction on site.
- The rubble-removal team used machines to gradually clear the area to the natural ground level, stopping for UXO removal or destruction as needed.
- At the natural ground level, the EOD team performed a survey of the newly exposed surface.
- Any additional UXO found was removed or destroyed, and remaining rubble at the natural ground level was removed.
- HI certified the surface UXO clearance and LMAC approved the clearance in accordance with IMAS.

EOD team leaders moved UXO considered to be safe to a central UXO demolition site in an open concrete bunker and destroyed it by detonation. UXO considered unsafe to move was destroyed on-site. On-site detonation temporarily closed the area, stopping all activities and resulting in worker evacuation.

By the end of the work in September 2009, a total of 11,348 items were found. Excluding weapons and small-arms ammunition, approximately 2,500 (22 percent) were hazardous explosive items. Figure 2 and Table 1 present UXO details and distribution.

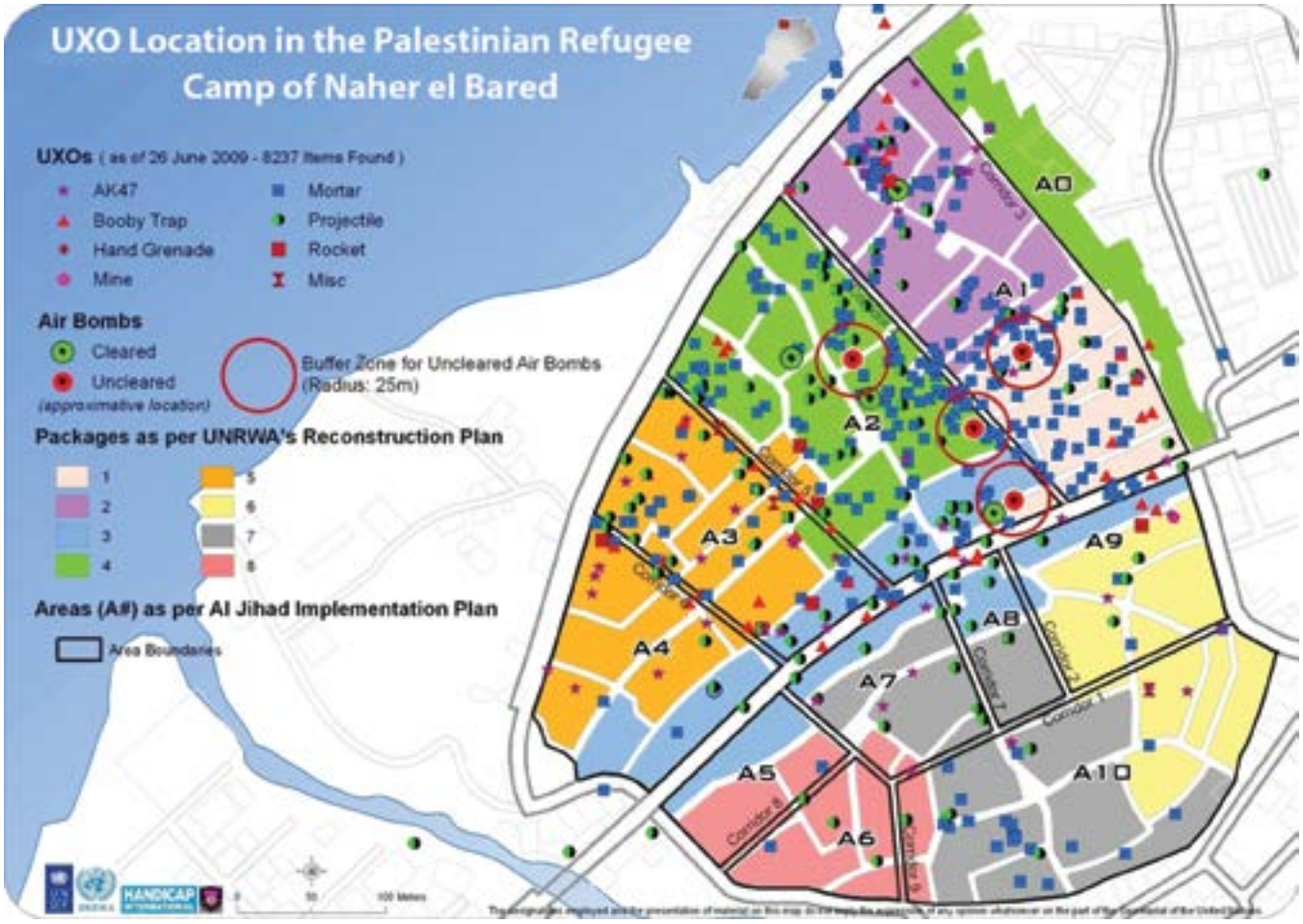

Figure 2. Sketch of NBC indicating location of UXO found in the Palestinian Refugee Camp of Naher el Bared by the end of August 2009.
Figure courtesy of UNDP, UNRWA and Handicap International.

Cooperation and Conflicting Interests

The contractual setup, including the decision to split the rubble-removal contract and the EOD contract into two independent contracts, proved crucial during the project implementation. All partners expressed the importance of proper coordination between the rubble-removal contractor and the EOD contractor to ensure NBC's successful recovery and reconstruction. However, at the project's inception, the partners did not fully understand the methodology of cooperation and team building essential to working in the field.

The EOD contractors' prioritization of safety in a time-variable contract and the rubble-removal contractor's prioritization of work speed due to a fixed-price, time-restricted contract were in disaccord, causing frustration and conflicts of interest throughout the project. The rubble-removal contractor allegedly did not understand the requirement of armoring the machines and providing personal protection equipment for demolition workers. Moreover, the EOD contractor often claimed that the rubble-removal contractor's personnel did not respect the safety rules. Additionally, due to the safety-distance requirements for rubble removal, allocating work for all four EOD teams on the site was difficult. As a result of positive dialogue, the two partners found a suitable modus operandi on a daily basis respecting safety and work performance to successfully complete the project.

Security, Health and Safety

The project's successful implementation depended on overall security in north Lebanon. During the implementation period, the situation was calm: No serious incidents occurred with no negative environmental impact on the work. According to the UNRWA-UNDP agreement, UNDP and UNRWA were responsible for the safety and security of the UNDP project-management unit. UNRWA was responsible for the safety of all UNDP staff on a daily basis within NBC, while UNRWA managed the relationship with NBC authorities, including the military and the EOD contractor. UNDP was responsible for the planning and management of health and safety on-site.

AMMUNITION TYPE	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Rifle grenades	12	111	184	197	125	89	68	89	90	49	48	32	1,094
Hand grenades	3	21	46	42	28	21	13	12	18	12	4	5	225
Projectiles	4	40	42	24	28	13	14	12	5	9	12	9	212
Mortar shells	6	57	95	80	88	53	26	40	27	35	31	22	560
Rockets	0	3	2	1	1	2	0	0	0	0	1	1	11
Bombs	0	0	0	1	1	2	0	0	0	0	0	0	4
RPGs	0	2	8	5	3	1	1	0	8	0	2	1	31
Mines	0	4	4	0	2	0	2	5	0	0	5	1	23
Fuzes	0	10	13	47	23	8	14	25	20	23	9	5	197
Small-arms ammunition	0	190	404	636	2,122	573	314	295	1,352	1,134	1,180	416	8,616
Miscellaneous	0	8	38	44	77	9	6	1	12	1	58	0	254
Weapons	1	5	6	13	22	6	21	3	6	19	13	6	121
Total	26	451	842	1,090	2,520	777	479	482	1,538	1,282	1,363	498	11,348
Booby traps	1	14	17	9	3	2	3	6	1	5	5	5	71

Table 1. Items of UXO found each month according to Handicap International's report from October 2008 to September 2009.
Table courtesy of author/CISR.

Success Criteria

- The rubble removal shall be completed in such a way that the respective areas are cleared and ready for construction works in accordance with the reconstruction project's time plan.
- Neighbors must be satisfied, and the number of claims by neighbors must be low.
- No serious accidents should occur.
- The greatest possible amount of rubble will be recycled and reused for the benefit of the NBC reconstruction project, and the smallest possible amount of materials will be disposed of at public landfill sites.
- The project should deploy a large number of local, NBC people.
- No negative discussions should be in the media.
- No additional costs should be incurred.

Figure 3. Success criteria of the NBC rubble-removal project.
Figure courtesy of the author/CISR.

Figure 4. NBC risk assessment by MAG. UXO-contaminated zones: Red area—heavy density (50 to 125 units of UXO per hectare) and possible five unexploded 250 kg air bombs; Amber area—normal density (13-49 units of UXO per hectare); Green area—light density (6–12 units of UXO per hectare).
Figure courtesy of MAG, Risk Assessment Report, April 2008.

The rubble-removal contractor presented a comprehensive health-and-safety plan, which included occupational health and work-safety precautions.

The EOD contractor was responsible for overall EOD and rubble-removal safety and managed the risk of uncontrolled UXO detonation in accordance with IMAS.

LAF controlled access to NBC and supervised on-site activities. The access procedures were somewhat problematic at the start of the project; however, thanks to very successful cooperation between the project partners and LAF, the daily work on-site ran smoothly throughout the project's duration.

Because of the high risk of uncontrolled UXO detonation, the EOD teams and the rubble-removal teams followed specific requirements in accordance with LMAC's accreditation of the EOD contractor's work procedures. The most important safety rules were as follows:

- All personnel on the work site were required to wear personal protective equipment, which included a helmet with an eye screen and a body vest.
- All machines operating on-site needed protection with armor and safety glass.
- The required safety distance between the machines and teams was 100 m (109 yd).
- The required safety distance between unprotected personnel and machines was 250 m (273 yd).
- All personnel working on site were provided information and UXO awareness training by the EOD contractor.
- Before entering the site, all personnel were required to report to the EOD contractor's checkpoint and be registered.

Deminers search for UXO amidst concrete rubble and iron bars.

During the rubble-removal project, uncontrolled UXO detonations caused seven accidents. One was very serious: A detonation hit two rubble-removal workers who were sorting waste and rubble. One of the workers was severely wounded, hospitalized for several days and was unable to work for five to six months. All critical accidents took place within the project's first four months. No accidents were reported after February 2009.

Besides the accidents, a total of eight uncontrolled explosions were reported, but they did not cause injury. The incidents involved small explosive items, such as hand grenades. These items detonated either when machines hit undiscovered UXO or during loading or unloading of rubble (i.e., when UXO in the rubble fell to the bottom steel plate of a truck).

Four air bombs (two 250-kg and two 400-kg bombs) were found and handed over to LAF. Considerable efforts were made to find the fifth bomb, but documentation of reported unexploded bombs was very poor. It was concluded that only four bombs were among the rubble.

Lessons Learned

The NBC rubble-removal project demonstrated that clearing war-damaged buildings containing UXO is both challenging and risky. Seven accidents and eight uncontrolled detonations during the clearance of the 200,000 sq m (50 ac) urban area were reported.

Splitting the overall rubble-removal project into two separate contracts—a fixed-price, rubble-removal contract and a time-variable, EOD contract—was not appropriate. The project setup with respect to the cooperation between the two contractors was problematic, especially regarding safety-measure planning and control, such as maintaining safe distances, wearing personal protection equipment, etc. In the future, it is recommended that rubble-removal contracts and EOD contracts be merged, either with a shared set of contractual conditions or linked together under full control of one project manager.

Further, rubble removal and EOD are based on different working cultures. Rubble-removal, demolition and building-waste management are part of the construction sector, while EOD has roots in the military sector and is performed under the terms of the emergency or development sector. The two work routines and cultures should be integrated at all levels. Emphasis should be placed on team building and mutual understanding between the two contactors in order to avoid conflicts of interest regarding speed and safety.

The history and timing of the NBC rubble-removal project demonstrated that this type of project requires detailed and careful planning together with highly professional project management and control.

Recommendations

Removal of destroyed buildings contaminated with UXO requires integrated management of rubble-removal work and EOD work. Mutual understanding of the work and associated risks, together with open cooperation between the two types of contractors, is a mandatory precondition for an effective and successful result.

Establishing the complete project organization at the project's start is required, and all planning documents, including work plans, health-and-safety management plans, as well as the quality-management plan, must be available from the beginning.

See endnotes page 66

Erik K. Lauritzen, managing director of Lauritzen Advising since 2008, is the founder of DEMEX Consulting Engineers, now NIRAS DEMEX, and has worked in the field of post-war and disaster reconstruction and demining for more than 30 years. He has worked with blasting and ammunition since 1980 and with post-war reconstruction and demining since the Balkan crisis in the early 1990s. Lauritzen holds a Master of Science in civil engineering, is a Lieutenant Colonel (reserve, retired) and was a member of the international mine action review board from 2005 to 2011, representing the Danish Ministry of Foreign Affairs and donors.

Erik K. Lauritzen
Managing Director
Lauritzen Advising
Egernvej 16
Frederiksberg / Denmark
Tel: +45 30 633 905
Email: ekl@lauritzenadvising.dk
Website: www.lauritzenadvising.dk